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CLUSTER ANALYSIS

of the

MINNESOTA TEACHER ATTITUDE INVENTORY

by

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Cluster Analysis of the Minnesota Teacher Attitude Inventory

Various aspects of teacher competencies have commanded the attention of research workers for many years. In part this has been the result of our changing concepts of the ways by which the learning process may be implemented and of our rather fluid objectives of education itself.

We have discovered certain facts relating to the methodology of presentation of subject matter for most effective learning to take place, but we know very little about the personal characteristics and attributes of the teacher that creates an atmosphere most conducive to the learning process. We have hypothesized that certain characteristics are most desirable in teachers, but when studies have been made relating these characteristics to measured pupil gain in knowledge of subject matter, the results have been rather disappointing. One principle shortcoming of this type of research has been the lack of adequate devices to measure pupil change in light of our present-day objectives of education.

A somewhat different approach to the problem has been made by W. W. Cook and his students at the University of Minnesota. Rather than measuring successful teaching by measured pupil gain in subject matter areas, they have studied certain aspects of teaching that are considered to be essential for most effective learning to take place. This approach has been in the area of teacher-pupil relations.

One of the most observable phenomena in the classroom is the social and emotional atmosphere that is created by the teacher. We find this in varying degrees from a very autocratically controlled classroom with rigid rules, regulations, standards, and with the maximum of extrinsic motivation, to a democratically controlled classroom with rather flexible rules, regulations, standards, and with emphasis placed upon student participation and a maximum of intrinsic motivation. Educational psychologists tell us that for effective learning to take place a high degree of intrinsic motivation is needed, and that one method of facilitating motivation is through harmonious interpersonal relations between the teacher and the pupils.

An instrument designed to predict the social-emotional atmosphere that a teacher creates in the classroom was developed by Leeds (4). This climate is predicted by the expressed attitudes of the teachers toward the students. These studies have resulted in an inventory known as the Minnesota Teacher Attitude Inventory (MTAI) (3). In three studies to determine the effectiveness of the MTAI to predict the teacher-student relationship, we find it to be about as efficient in predicting teacher-student relations as intelligence tests are in the prediction of scholastic success (2, 4, 5). Additional studies of the MTAI have indicated that the attitudes of teachers are relatively stable after the third year of teacher training (1). Scores also appear to be related to choice of teaching field. Teachers of early childhood classes were found to score significantly higher than any other group of teachers. In addition, teachers of special subjects were found to score significantly lower than teachers of early childhood or of academic subjects.

The MTAI was constructed by a purely empirical item analysis to select items that would most efficiently predict the combined criteria of ratings by the pupils, principals, and observers. This type of construction results in a single score for prediction and interpretation. It does not give us much information as to what is actually being measured.

It is the purpose of our present study to determine more precisely just what is being measured. That is, does the MTAI measure more than one factor and if so, what are the various factors and how can they be described and differentiated in terms of known psychological variables? So far the MTAI has been validated on public school teachers of grades 4 through 10. The vast majority of these teachers were elementary school teachers. Little is known about the validity of the inventory for other kinds of teachers, such as teachers who have had no formal preparation for teaching as might be found in a military training center. It is conceivable that the weighting of factors (if more than one exists) to yield maximum validity would be different for different kinds of teachers. Our present study is considered preliminary to future validity studies of different groups of teachers.

The study has been divided into two parts: a cluster analysis of the items of the MTAI into subtests, and a factor analysis of the subtests along with measures of known psychological variables.

The purpose of this report is to describe the assignment of items to the various clusters.

The Wherry-Gaylord procedure. We have two methods of approach from which to choose. One method is that of considering each item as a test and factoring an item intercorrelation matrix. The second method is by grouping the items into clusters and then factoring the clusters. Wherry and Gaylord (6) have proposed a method of clustering of items by an iterative process that will approximate the factor structure. This method was selected as the first of two stages in our analysis, since we also desired to factor a matrix of intercorrelations derived from the cluster scores and from some tests that would serve as guideposts in interpretation.

The Wherry-Gaylord procedure is an iterative process of extracting clusters of items based upon the internal consistency of intercorrelation of items. In general the steps are as follows:

a. Compute item-test correlations on orginal scoring key.
b. Construct a new scoring key (S_1) based upon those items with the highest correlations with the total test. (An r (tetrachoric) of .50 was arbitrarily set as the lower limit.)
c. Rescore with this new key (S_1) and compute the item-part score (S_1) correlation for each item.
d. Construct a new key (S_2) based upon items with increasing correlations and dropping those with decreasing correlations.
e. Continue the steps b, c, and d until stability of correlations is attained. This is indicated when no new items are gained and none lost for this particular scoring key.

The original assignment of items to clusters. The original assignment of items to clusters was determined by applying the Wherry-Gaylord procedure to the test results of a group of 82 teachers from four public school systems in central Missouri. A "rights" key was used for scoring rather than the published "rights-minus-wrongs" key. (A correlation of .97 is reported in the manual between the two methods of scoring.) This was done to simplify the work.

The first scoring key used in the iterative process for cluster 1 was made up from those items that had a correlation of .50 or more with the total test score. After six iterations, a cluster of 47 items remained when stability of item-cluster correlation was attained.

All of the items not assigend to cluster 1 were used in the first scoring key for cluster 2. The iterative process was carried out for all 150 items for eight iterations until stability of item placement was reached. The result of these iterations yielded a group of items identical with cluster 1. For the third cluster, the first scoring key was based upon the items that had a negative correlation on cluster 1. The result of the iterations for cluster 3 also yielded identical items and loadings as was found for cluster 1.

This method of leaving all the items (150 in this case) in the cluster analysis verified our suspicion that regardless of where we start the iterative process, we will extract the most dominant cluster of items in the test. For this reason clusters 2 and 3 were discarded and a procedure was adopted whereby once an item had been assigned to a cluster, it was removed from the analysis.

The first scoring key for cluster 4 was based upon the item-test correlations with the 47 items of cluster 1 removed from the test. After three iterations, stability was reached. Twenty-two items were tentatively assigned to cluster 4.

This same process was continued until cluster 12 was extracted. The number of iterations and items assigned is shown in Table 1.

TABLE 1

ORIGINAL ASSIGNMENT OF ITEMS TO CLUSTERS

Clusters	Number of Iterations	Number of Items
	8	4*
4	3	22
5	4	19
6	12	11
7	4	14*
8	2	10
9	3	7
10	2	5
11	2	5
12	3	4

*On cluster 7 and after, items were assigned to clusters with correlations as low as .44 where there was a paucity of responses to that item or where one answer sheet could effect this great a change from a correlation of .50.

TABLE 2

CHANGE IN ITEM ASSIGNMENT TO CLUSTERS BASED ON FIRST REVISION

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	No. of items assigned to a cluster when							
Cluster	"Rights only" scoring formula used	"Rights-minus-Wrongs" scoring formula used	No. of items retained in Column (2) from Column (1)	Items gained by (a)	Items gained by (b)	No. of items dropped from this cluster and reassigned to another cluster	No. of items dropped from this cluster and assigned to the residual by (c)	No. of items dropped from this cluster and assigned to the residual by (d)
1	47	29	29	0	0	4	6	8
4	22	17	15	2	0	0	3	4
5	19	16	15	0	1	0	2	2
6	11	14	11	0	3	0	0	0
7	14	16	11	1	4	1	1	1
8	10	10	6	0	4	1	3	0
9	7	5	4	0	1	0	3	0
10	5	4	3	1	0	0	1	1
11	5	7	4	1	2	0	1	0
12	4	4	3	1	0	0	1	0
Total	144*	122	101	6	15	6	21	16

(a) Items gained as the result of increased correlation with the cluster.
(b) Items gained as the result of multiple scoring.
(c) When the item-cluster correlation dropped below .50.
(d) When the assignment of an item to a cluster was indeterminate due to several moderately high item-cluster correlations.
* There were 6 items in the original residual.

The first revision. By this time we had lost some of our confidence in our assumption that a "rights" scoring key would yield the the same results as a "rights-minus-wrongs" scoring key. To be consistent with the published method of scoring, each of the items was correlated with each of the clusters, using "rights-minus-wrongs" scoring. As a result of this method of scoring, some of the items were reassigned to other clusters or to the residual pool of items on the following basis:

a. When the item-cluster correlation dropped to below .50, the item was placed in the residual pool, or
b. When an item correlated rather highly with several clusters, making it difficult to determine its proper assignment, the item was assigned temporarily to the residual pool, or
c. When it appeared appropriate that the item should be assigned to a different cluster because of a higher correlation with the other cluster.

This revision indicated that several of the items were rather unstable. This was especially true with those items in cluster 1 where the number of items assigned dropped from 47 items to 29 items. Of the 18 items that were dropped from the cluster, 4 items were assigned to other clusters, on 6 items the item-cluster correlation dropped below .50, and on the remaining 8, the correlations indicated a general lack of stability. The results of the changes in assignment is shown in Table 2. It also gave evidence that certain items should have multiple scoring, i.e., be scored on more than one cluster.

The second revision. In view of the instability of some of the items, it was decided that the final assignment of items would be based upon the stability found on three separate samples, rather than on just one. A correlation of .40 or more was arbitrarily set as an indicator of sufficient stability of an item-cluster correlation for purposes of assignment.

The second sample was made up of 100 experienced teachers doing graduate work in education at the University of Missouri. The number of years of experience varied from 1 year to 31 years. (See Table 3.)

This group of answer sheets was scored using the "rights-minus-wrongs scoring keys for the revised clusters indicated in Table 2. Item-cluster correlations were computed. The results indicated the need for extended use of multiple scoring, i.e., for scoring on more than one cluster. A reassignment of items to clusters was made. An item was assigned to a cluster if the item-cluster correlation was .50 or higher for each of the first and second samples. No restriction was placed on the number of clusters any one item might be assigned to. Table 4 shows the number of items assigned on the basis of the second revision.

After the correlationswere computedon the second sample, it appeared likely that another cluster might be found in the residual. The residual was divided into two groups: those items with fairly high correlations with some of the clusters, and those items that had predominantly zero or negative correlations with the other clusters. The first of these two groups was called cluster 13 for scoring on the third sample.

The final assignment of items. The third sample was taken from five different groups. These groups varied from freshmen to graduate students and from no teaching experience to 30 years of teaching experience. However, all of them had declared teaching to be their chosen occupation. To deliberately insure heterogeneity within the sample the highest scoring ten and the lowest scoring ten answer sheets were selected from each of the following groups:

a. Freshmen enrolled in the College of Education, University of Missouri.
b. Sophomores and juniors enrolled at the St. Cloud State Teachers College, St. Cloud, Minnesota.
c. Juniors and seniors enrolled at the St. Cloud State Teachers College, St. Cloud, Minnesota.

d. Graduate student in counseling and guidance, University of Missouri.
e. Graduate students in education, Michigan State College.

None of these had been used in the first two samples.

The final assignment of items to a cluster was made when a correlation of .40 or more was obtained for an item with a cluster on each of the three samples.

TABLE 3
YEARS OF TEACHING EXPERIENCE OF PERSONS COMPRISING SECOND SAMPLE

Years	1 - 2	3 - 5	6 - 10	11-- 20	over 20
No. of Teachers	24	17	20	28	11

TABLE 4

ITEM ASSIGNMENT ON SECOND REVISION

Cluster	No. of Items
1	34
4	24
5	22
6	9
7	43
8	22
9	7
10	6
11	11
12	9
Residual	43

TABLE 5

FINAL ASSIGNMENT OF ITEMS TO CLUSTERS

Cluster	No. of Items
1	30
4	23
5	17
6	6
7	41
8	22
9	6
10	4
11	9
12	9
13	22
Residual	57

Examples of the item-cluster correlations and final assignment to clusters are shown below. The entries are the correlations based on "rights-minus-wrongs" scoring. The decimal points preceding the correlations have been omitted. The spaces were left blank (--) when the correlations were negative.

(a) Item No. 1. "Most children are obedient."

	Clusters										
	1	4	5	6	7	8	9	10	11	12	13
First sample	20	07	--	--	23	15	15	32	42	15	32
Second sample	42	10	35	05	43	10	35	27	23	27	27
Third sample	22	28	38	00	55	60	15	38	22	40	55

This item was assigned to the residual pool.

(b) Item No. 2. "Pupils who act smart' probably have too high an opinion of themselves."

	Clusters										
	1	4	5	6	7	8	9	10	11	12	13
First sample	18	73	32	40	52	48	18	18	62	18	48
Second sample	35	78	28	--	19	20	10	--	58	12	12
Third sample	55	82	71	61	67	55	55	40	82	75	61

This item was assigned to clusters 4 and 11.

(c) Item No. 12. "Pupils should be required to do more studying at home."

	Clusters										
	1	4	5	6	7	8	9	10	11	12	13
First sample	45	45	77	22	34	45	45	14	45	37	77
Second sample	--	23	58	--	15	00	19	--	13	00	19
Third sample	32	70	75	47	53	39	62	53	47	73	53

This item was assigned to cluster 5.

Appendix A gives the specific final assignment to clusters of each item. Table 5 shows the number of items in the final assignment to each of the clusters.

Summary. The MTAI is being subjected to an analysis to determine more precisely what is being measured. This analysis is being conducted in two stages: first, a cluster analysis of the items into subtests, and secondly, factor analysis of the subtests along with measures of known psychological variables. This report is concerned with the assignment of the items into clusters or subtests.

The assignment of items to clusters was based upon an iterative procedure developed by Wherry and Gaylord. This procedure was first applied on a sample of tests administered to 82 teachers. From this original assignment of items to clusters, revisions were made on the basis of data obtained on two additional samples of 100 persons each. The second sample was made up of experienced teachers doing graduate work in education. The third sample was drawn from five groups varying from freshmen enrolled in a school of education to graduate students in education, many with several years of teaching experience.

The final assignment of items to clusters was made when an item correlation of .40 or more was found on each of the three samples. Eleven clusters plus a residual pool of items have been identified. Several of the clusters contain so few items that results of analyses based on them will be suggestive only. More items will need to be written for several of these clusters if the factor analysis results look promising.

Several of our staff, independently and collectively, have attempted to define or label the clusters to no avail. There appeared to be no logical frame of reference by which to differentiate one cluster from another. The labeling of the clusters or factors will await further study.

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APPENDIX A

ASSIGNMENT OF ITEMS FOR CLUSTER SCORING

Item	1	4	5	6	7	8	9	10	11	12	13	R*
1.	--	--	--	--	--	--	--	--	--	--	--	1
2.	--	2	--	--	--	--	--	--	2	--	--	--
3.	--	--	--	--	--	3	--	--	--	--	--	--
4.	--	4	--	--	--	--	--	--	--	--	--	--
5.	--	--	--	--	--	--	--	5	--	--	--	--
6.	--	--	--	--	--	--	--	6	--	--	--	--
7.	7	--	--	--	--	--	--	--	--	--	--	--
8.	--	--	--	--	--	--	--	--	--	--	--	8
9.	--	--	--	--	--	--	--	--	--	--	--	9
10.	--	--	--	--	--	--	--	--	--	--	--	10
11.	--	--	--	--	--	--	--	--	11	--	--	--
12.	--	--	12	--	--	--	--	--	--	--	--	--
13.	--	--	--	--	13	13	--	--	13	--	--	--
14.	14	--	--	--	14	--	--	--	--	--	14	--
15.	--	15	--	--	--	--	--	--	--	--	--	--
16.	--	--	--	--	--	--	--	--	--	--	--	16
17.	--	--	--	--	--	--	--	--	--	--	--	17
18.	--	--	--	--	18	--	--	--	--	--	--	--
19.	--	19	--	--	19	--	--	--	--	--	19	--
20.	--	--	--	--	20	--	--	--	--	--	--	--
21.	--	--	--	--	--	--	--	--	--	--	--	21
22.	--	--	--	--	--	--	--	--	--	--	--	22
23.	--	23	23	--	--	--	--	--	--	--	23	--
24.	--	--	--	--	--	--	--	--	--	--	24	--
25.	25	--	--	--	25	25	--	--	--	--	25	--
26.	--	--	--	--	--	--	--	--	--	--	--	26
27.	--	--	--	--	--	--	--	--	--	--	--	27
28.	--	--	--	--	--	--	--	--	--	--	--	28
29.	--	--	--	--	--	--	29	--	--	--	--	--
30.	--	--	--	--	--	--	--	--	--	--	--	30
31.	--	--	--	--	--	31	--	--	--	--	--	--
32.	--	--	--	32	--	--	--	--	--	--	--	--
33.	--	--	--	--	--	--	--	--	--	--	--	33
34.	--	--	34	--	--	--	--	--	34	--	--	--
35.	--	--	--	--	--	--	--	--	--	--	--	35
36.	--	--	36	--	--	--	--	--	--	--	--	--
37.	37	--	--	--	37	37	--	--	--	--	--	--
38.	--	--	38	--	--	--	--	--	--	--	--	--
39.	39	--	--	--	39	--	--	--	--	--	--	--
40.	40	--	--	--	40	40	--	--	--	--	--	--
41.	41	--	--	--	41	41	--	--	--	--	--	--
42.	42	--	--	--	--	--	--	--	--	--	--	--
43.	43	--	--	--	43	--	--	--	--	43	43	--
44.	--	44	--	--	44	--	--	--	--	44	--	--
45.	--	--	--	--	--	--	--	--	45	--	--	--
46.	--	--	--	--	--	--	--	--	--	--	--	46
47.	--	--	--	--	--	--	--	--	--	--	--	47
48.	--	48	--	--	48	--	--	--	--	--	48	--
49.	--	--	--	--	--	49	--	--	--	--	--	--
50.	--	50	50	--	50	50	50	--	--	--	50	--

*Residual

ASSIGNMENT OF ITEMS FOR CLUSTER SCORING
(cont.)

Item	1	4	5	6	7	8	9	10	11	12	13	R
51.	--	51	--	--	51	--	--	--	--	--	--	--
52.	--	--	--	--	--	--	--	--	--	--	52	--
53.	--	--	--	--	--	--	53	--	--	--	--	--
54.	--	--	--	54	--	--	--	--	--	--	--	--
55.	--	--	--	--	--	--	--	--	--	--	--	55
56.	--	--	--	--	--	--	--	--	--	--	--	56
57.	--	57	57	--	--	--	--	--	--	--	57	--
58.	58	--	--	--	58	58	--	--	--	--	--	--
59.	--	--	--	--	--	--	--	--	--	--	--	59
60.	80	--	--	--	--	--	--	--	--	--	--	--
61.	--	--	--	--	61	--	--	--	--	--	--	--
62.	--	--	--	--	--	--	--	--	--	--	--	62
63.	--	--	--	--	--	--	--	--	--	--	--	63
64.	--	--	--	--	--	--	--	--	--	--	--	84
65.	--	--	65	--	--	85	65	--	--	--	65	--
66.**												
67.	--	--	--	--	67	--	--	--	--	--	--	--
68.	--	--	--	--	--	--	--	--	--	--	--	88
69.	--	89	--	--	--	--	--	--	--	--	--	--
70.	--	--	--	--	--	--	--	--	--	--	--	70
71.	--	--	--	--	--	--	--	--	--	--	--	71
72.	--	--	--	--	--	--	--	--	--	--	--	72
73.	--	--	--	--	--	--	--	--	--	--	--	73
74.	--	--	--	--	--	--	--	--	--	--	--	74
75.	--	--	--	--	--	--	--	--	--	--	--	75
76.	--	---	--	--	--	--	--	--	--	--	--	76
77.	--	--	--	--	--	--	--	--	--	--	--	77
78.	--	--	--	--	--	--	--	--	--	--	--	78
79.	--	--	79	--	--	--	--	--	--	--	--	--
80.	--	80	80	--	80	80	80	80	--	80	80	--
81.	--	--	--	--	--	--	--	--	--	81	--	--
82.	--	--	--	--	--	--	--	--	--	--	--	82
83.	--	--	--	--	83	--	--	--	--	--	--	--
84.	--	84	--	--	--	--	--	--	84	--	--	--
85.	--	85	--	--	85	--	--	--	85	85	85	--
86.	86	86	--	--	86	86	--	--	88	--	88	--
87.	--	--	--	--	--	87	--	--	--	--	--	--
88.	--	--	--	88	--	--	--	--	--	--	--	--
89.	--	--	--	--	--	---	--	--	--	--	--	89
90.	--	--	90	--	--	--	--	--	--	--	--	--
91.	--	--	--	--	--	--	--	--	--	--	--	91
92.	--	--	--	--	--	--	--	--	--	--	--	92
93.	--	--	--	--	--	--	--	--	--	--	93	--
94.	94	94	94	--	94	--	--	--	--	94	--	--
95.	--	--	--	--	--	--	--	--	--	--	--	95
96.	--	--	--	--	--	--	--	--	--	--	--	96
97.	--	--	--	--	--	--	--	--	--	--	--	97
98.	--	--	--	98	--	--	--	--	--	--	--	--
99.	99	--	--	--	99	99	--	--	--	--	--	--
100.	--	--	100	--	--	--	--	--	--	--	--	--

**Assignment of items 66 and 135 to clusters was not possible due to changes on the forms of the test administered to the three groups.

ASSIGNMENT OF ITEMS FOR CLUSTER SCORING
(cont.)

Item	1	4	5	6	7	8	9	10	11	12	13	R
101.	--	--	101	--	--	--	--	101	--	--	--	--
102.	102	102	--	--	102	--	--	--	--	102	102	--
103.	--	--	103	103	--	--	--	--	103	--	--	--
104.	--	104	--	--	--	--	--	--	--	--	--	--
105.	105	--	--	--	105	--	--	--	--	--	--	--
106.	--	--	--	--	--	--	--	--	--	--	--	106
107.	--	--	--	107	--	--	--	--	--	--	--	--
108.	--	108	--	--	--	--	--	--	--	--	108	--
109.	--	109	--	--	--	--	--	--	--	--	--	--
110.	--	--	--	--	110	--	--	--	--	--	110	--
111.	--	--	--	--	--	--	--	--	--	--	--	111
112.	--	--	--	--	--	--	--	--	--	112	--	--
113.	--	--	--	--	--	--	--	--	--	--	--	113
114.	--	114	114	--	--	--	--	--	--	--	114	--
115.	--	--	--	--	115	115	--	--	--	--	--	--
116.	--	116	116	--	116	--	--	--	--	--	116	--
117.	--	--	--	--	--	--	--	--	--	--	--	117
118.	--	--	--	--	--	--	--	--	--	--	--	118
119.	119	--	--	--	--	--	--	--	--	--	--	--
120.	--	--	--	--	--	--	--	--	--	--	--	120
121.	--	--	--	--	--	--	--	--	--	--	--	121
122.	--	--	--	--	--	--	--	--	--	--	--	122
123.	123	--	--	--	123	--	--	--	--	--	--	--
124.	--	--	--	--	124	--	--	--	--	--	--	--
125.	--	--	--	--	--	--	--	--	--	--	--	125
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